

NATIONAL ASSOCIATION OF GEOLOGY TEACHERS

EASTERN SECTION

ANNUAL SPRING FIELD TRIPS

April 14, 1973

HOST

University of Pittsburgh
Pittsburgh, Pennsylvania

FIELD TRIP LEADERS

- TRIP 1. Dolores Cobucci, Department of Earth and Planetary
Sciences, University of Pittsburgh
- TRIP 2. Dr. Norman Flint, Department of Earth and Planetary
Sciences, University of Pittsburgh
- TRIP 3. Dr. Jessie Donahue, Department of Earth and Planetary
Sciences, University of Pittsburgh
Host: Duquesne Light Company

FIELD TRIP COORDINATOR

Dr. Harold B. Rollins, Department of Earth and Planetary
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THE GEOLOGY OF CHESTNUT RIDGE ANTICLINE
IN THE VICINITY OF LAUREL CAVERNS
FAYETTE COUNTY, PENNSYLVANIA

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PREPARATION

Wear field clothing. Those among us who are taking a first field trip today may not possess field boots, but tennis shoes or oxfords will do.

We will visit excellent fossil collecting sites: bring some collecting bags or sacks. This is a "tame" field trip: no strenuous climbing or hiking, but if you're well past 90 you should be accompanied by someone who will wield your hammer for you.

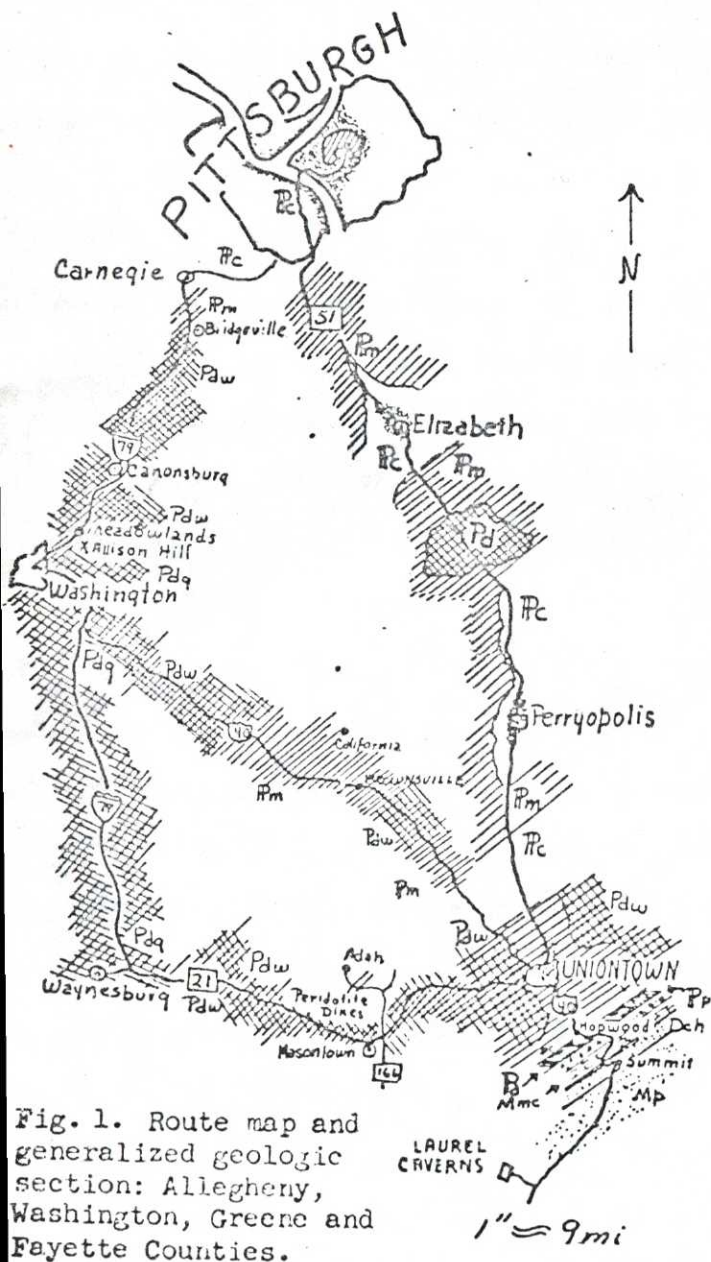
Our bus leaves the loading dock at Langley Hall (Ruskin Street side) at 11:15 A.M. We will have lunch at the Cave Inn around 1:00 P.M. Menus listing group rates for meals will be given to you enroute.

Those who will visit the commercial portion of Laurel Caverns will be charged student rates (\$1.00) for the 25-minute guided tour. An excursion through the "unexplored" sections will take at least two hours, and this is an unguided tour. Try to find your way out in time to take the bus back to Pittsburgh with the rest of us.

We will leave the caverns area at 5:00 P.M. and should be back on campus by 6:00 P.M.

GENERAL GEOLOGIC ROUTE MAP FROM PITTSBURGH TO CHESTNUT RIDGE AND LAUREL CAVERNS

STRATIGRAPHIC COLUMN AND ROCK DESCRIPTION



P E N N S Y L V A N I A N M I S S I S S I P P I A N D E V O N I A N	QUATERNARY	Qa	Clays, sands, and gravels on terraces and abandoned river channels.
	DUNKARD (Upper Barren Measures) ± 300'	Pd	Greene Fm. Thin coal seams, claystones, non-marine shales, limestones, and sandstones. Washington Fm.
	MONONGAHELA (Upper Productive) ± 400'	Pm	Waynesburg coal Uniontown coal Benwood Ls. Sewickley coal Redstone coal Pittsburgh coal Thick seams of good quality coals of which the Pittsburgh is the most important. Non-marine Benwood limestone 100' to 120' thick.
	CONEMAUGH (Lower Barren) 750'-800'	Pc	Casselman Fm. Non-marine units of massive to shaley sandstones, carbonaceous shales and red beds. Morgantown Ss. Birmingham units Duquesne Ls. Glenshaw Fm. Thin but persistent marine limestones, thin coals and coaly shales, massive sandstones and red beds. Ames Ls. Pch Redbeds Woods Run Ls. Pine Creek Ls. Brush Creek Ls.
	ALLEGHENY (Lower Productive) 250'-300'	Pa	Freeport coals Killbuck coals Clarion coal Brookville coal Good quality coals and fire clays, shales, siltstones and sandstones.
	POTTSVILLE (Conglomerate Series) ± 200'	Pp	Homewood Ss. Merced coal Connoquenessing Ss. Duakertown coal Sharon Ss. Alternating beds of coarse, resistant sandstones and thin coal seams.
	MAUCH CHUNK ± 250'	Mmc	Upper part about 100' red shales and thin beds of sandstone underlain by 17' very fossiliferous Wymys Gap marine limestone. Lower part, red + green siltstones + shales underlain by about 3" marine Deer Valley limestone.
M I S S I S S I P P I A N	LOYALHANNA 50'-60'		Prominently cross-stratified siliceous limestone.
	POCONO (Burgoon, "Big Injun") 500'-600'	Mp	Grey to greenish, fine to medium-grained sandstones, some shales and siltstones.
D E V O N I A N	JENNINGS (Chemung) ± 5000'	Dch	Poorly fossiliferous marine units, thinly bedded sandstones and shales.

INTRODUCTION

This excursion extends from the axis of the Pittsburgh-Huntington Basin to Chestnut Ridge Anticline, the first major fold in Pennsylvania as one proceeds in an easterly direction from the Ohio border. The anticline lies on the east flank of the basin: a southwesterly plunging synclinorium comprised of sedimentary strata with minor local flexures and broad, gentle folds having flanks which dip less than 2° . In contrast, the western part of the basin changes gradually from folded rocks to nearly horizontal and relatively undisturbed beds which thin out as they ascend the Cincinnati Arch.

The pertinent strata range in age from Permian to Devonian. Both marine and non-marine units are well exposed along the route and at the locales we will visit.

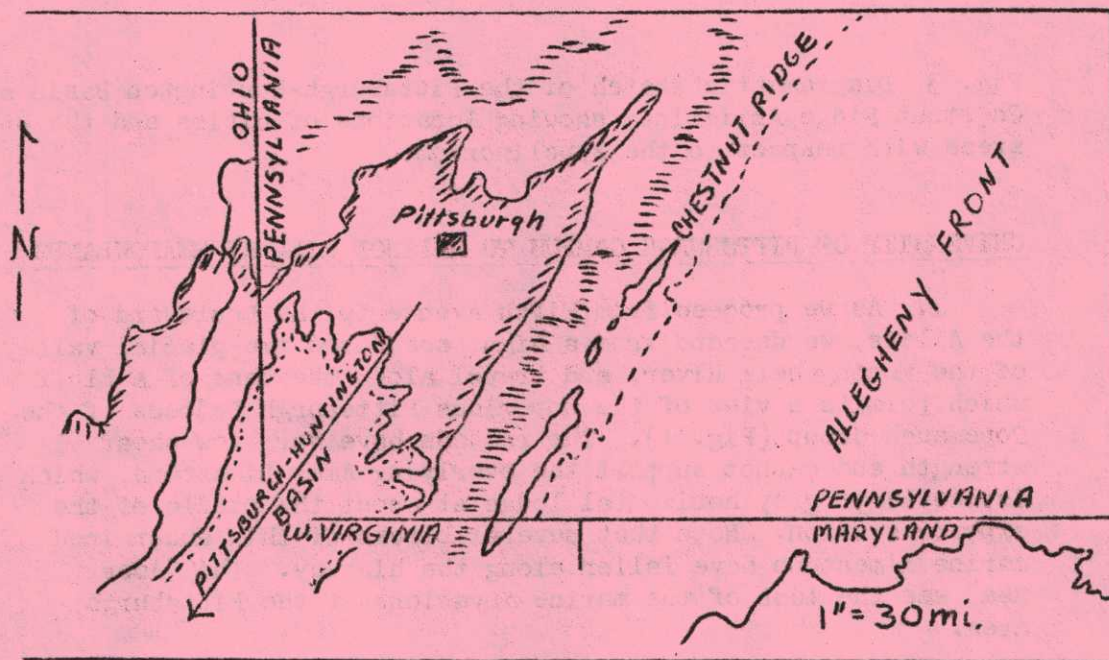


Fig. 2 Index map of southwestern Pennsylvania and adjoining states showing relationship of Chestnut Ridge Anticline to the Pittsburgh-Huntington Basin and other geologic features.

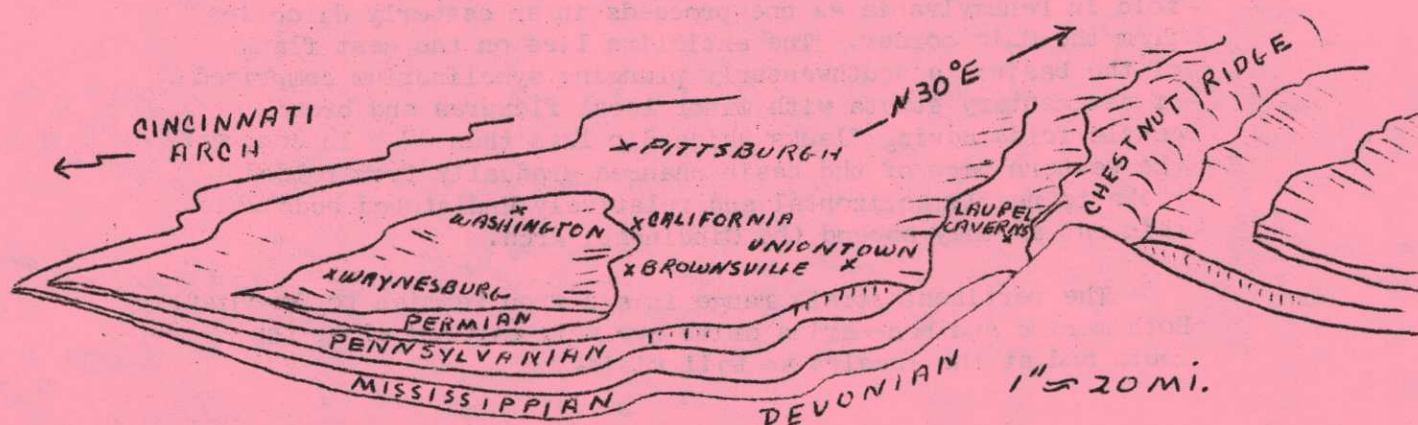


Fig. 3 Diagrammatic sketch of the Pittsburgh-Huntington Basin and Chestnut Ridge Anticline, showing locations of cities and the study areas with respect to the synclinorium.

UNIVERSITY OF PITTSBURGH CAMPUS TO ALLISON HILL AT MEADOWLANDS

1. As we proceed from Fifth Avenue to the Boulevard of the Allies, we descend from a high, abandoned pre-glacial valley of the Monongahela River, and travel along the base of a bluff which permits a view of the notorious Pittsburgh Redbeds of the Conemaugh Group (Fig. 1). The redbeds have very low shear strength and cannot support the overlying Ames Limestone, which is the light grey horizontal ledge at about the middle of the exposed section. Note that several blocks of this undermined marine limestone have fallen along the highway. The "Ames Sea" was the last of the marine invasions of the Pittsburgh area.

2. Our route veers southward across the Monongahela River via the Fort Pitt Bridge. Look ahead at the hillside through which the tunnels were built. The massive sandstone unit at portal level is the Morgantown; the Ames is below us near river level.

3. We enter Interstate 79 just north of Bridgeville. The steep cliffs on both sides of the highway just off the ramp expose the Benwood fresh-water carbonate. This pale yellow, blocky, dolomitic limestone is exposed in several places along our route and will help keep us oriented stratigraphically. Note, too, that the Benwood is strewn along the roadside due to jointing and differential erosion.

STOP 1: ALLISON HILL AT EXIT 8 (RACETRACK ROAD)

4. If you have been noticing the outcrops along our way, you will remember that we traveled down-section from a Benwood exposure just a few hundred feet north of this intersection. The hill exposes the lowest part of the Benwood and only a sooty smear of the Sewickley coal. The Pittsburgh coal is near Chartiers Creek level at an elevation of 980 feet.

The hillside across Racetrack Road and along I-79 was recently the site of strip mining. After the coal was removed the excavation was back-filled and seeded by the mining company.

5. Walk up the gravel road to a broad bench at an elevation of about 1200 feet. This bench was cut to protect the highway below from the falling sandstone boulders which slip away from their joint faces along clay seams below and within the sandstone unit.

6. I have named it Allison Hill because it overlooks Allison Hollow and an old Allison Station railway stop. The flat, grassy terrace along Old Route 19 is all that remains of a long-abandoned trolley system which once connected towns along Chartiers Creek from Washington, Pa., to Pittsburgh. The trolleys used to pitch and roll over the uneven tracks because of subsidence of the ground under which the Pittsburgh coal was mined.

7. Where are we with respect to geologic time, in Permian or in Pennsylvanian units? In September 1972, the I.C. White Memorial Symposium was held in Morgantown, West Virginia for the purpose of determining precisely where the Pennsylvanian/Permian boundary should be drawn. Meanwhile, the published stratigraphic columns including the Monongahela and Dunkard groups show a dashed line or a question mark at the approximate boundary. Here, high on a bench cut on Allison Hill, we are standing at the position of the question mark!

8. Follow the jeep trail leading upward from the bench for about 50 feet. We will uncover some fossiliferous claystone with a foxhole shovel. Remove the fossils carefully then wrap them in paper. You should use a plastic spray on them if you plan to use them for teaching or display. You might look for a rather unusual thorned branch, possibly Antholithes priscus (Newberry, 1873).

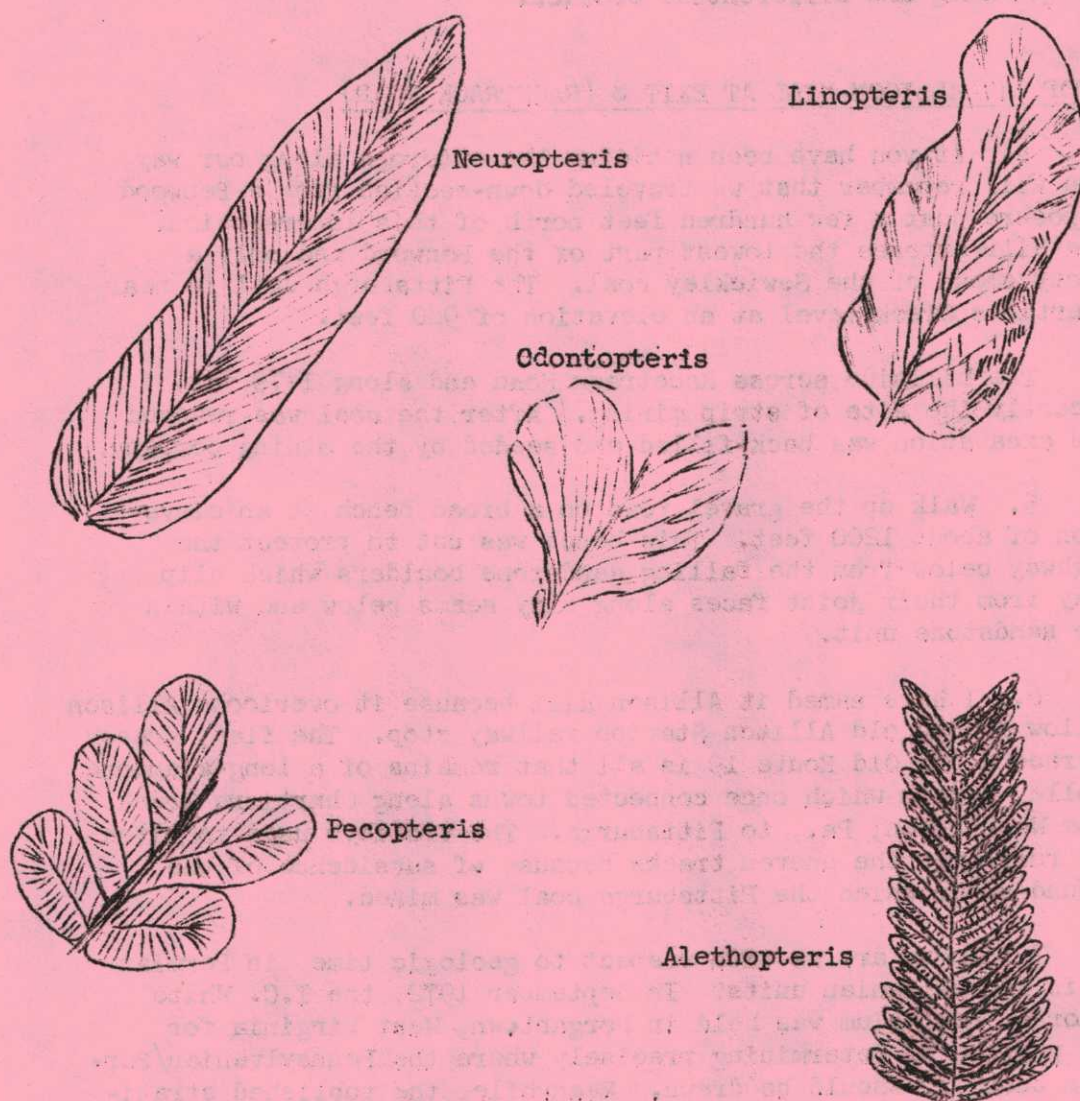


Fig. 4 Permo-carboniferous plant fossils of ferns and fern-like leaves hand-drawn from actual samples found at the Allison Hill site.

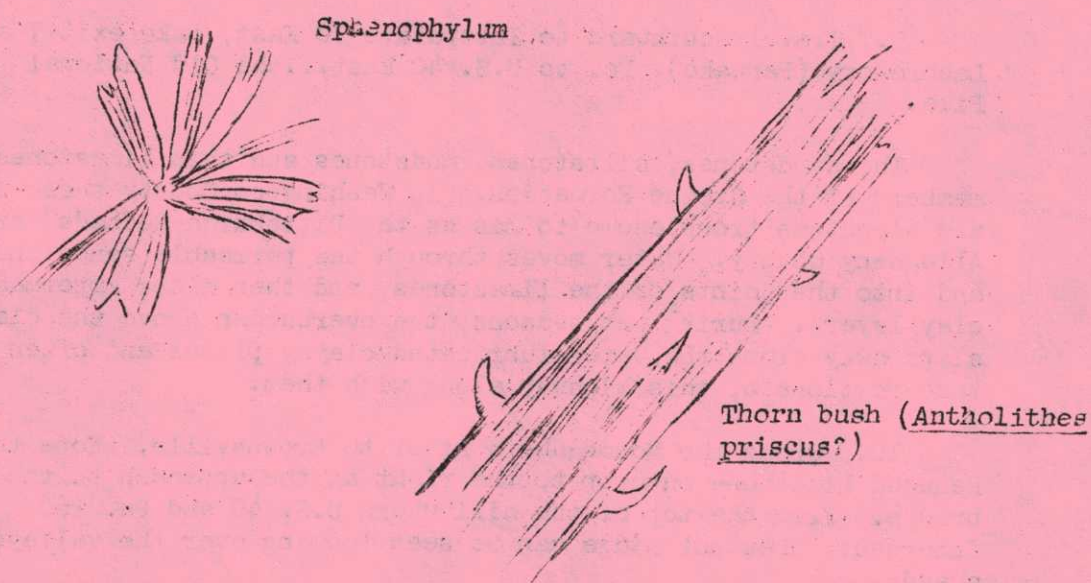


Fig. 5 Fossil bush plants hand drawn from samples collected at Allison Hill site.

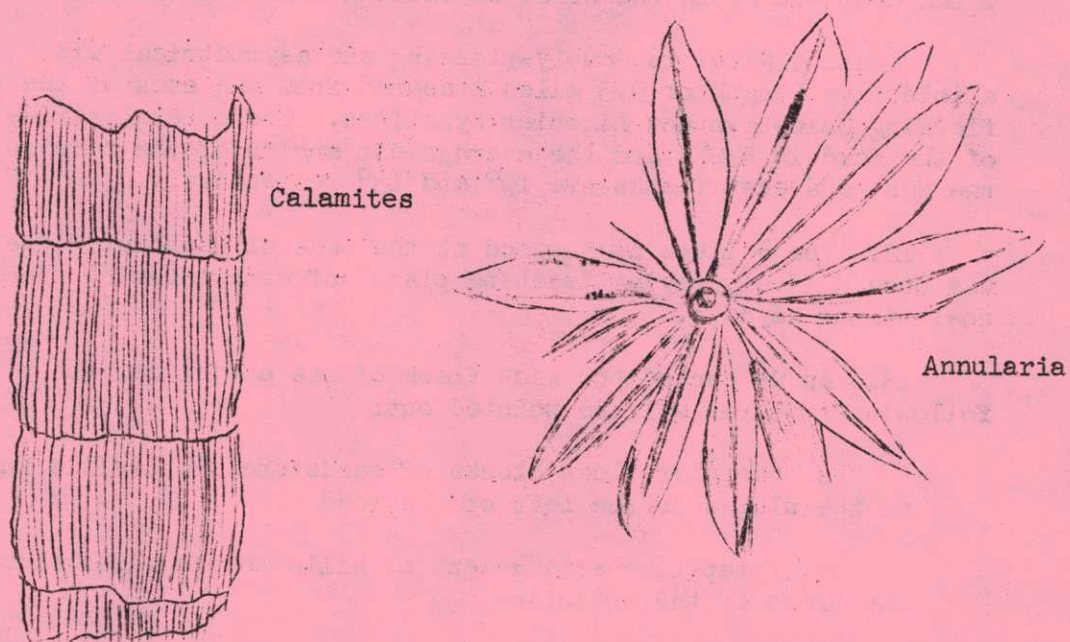


Fig. 6 Fossil trees: trunk and leaves recovered from Allison Hill.

ALLISON HILL AT MEADOWLANDS TO CHESTNUT RIDGE AND LAUREL CAVERNS

9.. Travel southward to Interstate 70 East, take exit 7 at Laboratory (Pancake), Pa. to U.S. 40 East...the Old National Pike.

The sandstones, siltstones, mudstones and thin limestones are members of the Greene Formation. In Washington County these units are almost as troublesome to mas as the Pittsburgh Redbeds are in Allegheny County. Water moves through the permeable sandstones and into the joints of the limestones, and then along impermeable clay layers. During wet seasons, the overburden above the clay slips away along the water-lubricated clayey planes and often take portions of this highway along with them.

10. Cross the Monongahela River to Brownsville. Note the Benwood Limestone outcrop to the right at the approach to the bridge. From the top of the hill where U.S. 40 and Pa. 166 intersect, Chestnut Ridge can be seen looming over the valleys ahead.

11. Uniontown is situated along the structural axis of the Uniontown Syncline. From this axis which we cross near the center of town, we will travel down-section from the Permian rocks of the syncline (Washington Formation) to Devonian rocks which crop out along the crest of Chestnut Ridge Anticline.

Chestnut Ridge is doubly-plunging and asymmetrical with a fold wave length of 9.3 miles measured from the axes of the flanking Uniontown and Ligonier synclines. The general strike of the fold is N30°E and the average dip angles of the beds on the west and east flanks are 19° and 13° respectively.

12. The village of Hopwood at the base of Chestnut Ridge was once a lively payday "meeting place" of miners during the coal mining heydays.

13. As we ascend the west flank of the anticline, the following features will be pointed out:

- a. angular float blocks of sandstone (Pottsville Fm.) on the slopes to the left of the road
- b. step-like arrangement of hills to the right along the trend of the anticline
- c. steeply-dipping rocks in the roadcut one mile from Hopwood

d. a thrust fault

e. the unconformable contact between Pennsylvanian and Mississippian rocks: the boundary between the Pottsville Formation and the underlying Mauch Chunk Redbeds, and Mississippian-Devonian contact

f. the Mississippian-Devonian contact.

14. Turn right at the summit which lies about 1/10 mile east of the axis of the fold. From a vantage point near the golf course, look left to the gently dipping east flank of the anticline.

15. Follow the Summit Road for 6 miles, turn right to Laurel Caverns.

The caverns study area comprising one-half mile² lies within the Brownfield, Pennsylvania 7 $\frac{1}{2}$ ' quadrangle between 42'30" and 42'09" West Longitude, and 47'30" and 47'59" North Latitude. This site is selected for field trips because it is readily accessible to several colleges where earth science is taught, and because various aspects of geology such as structure, geomorphology, stratigraphy, paleontology, paleoecology, and environmental geology can all be studied here.

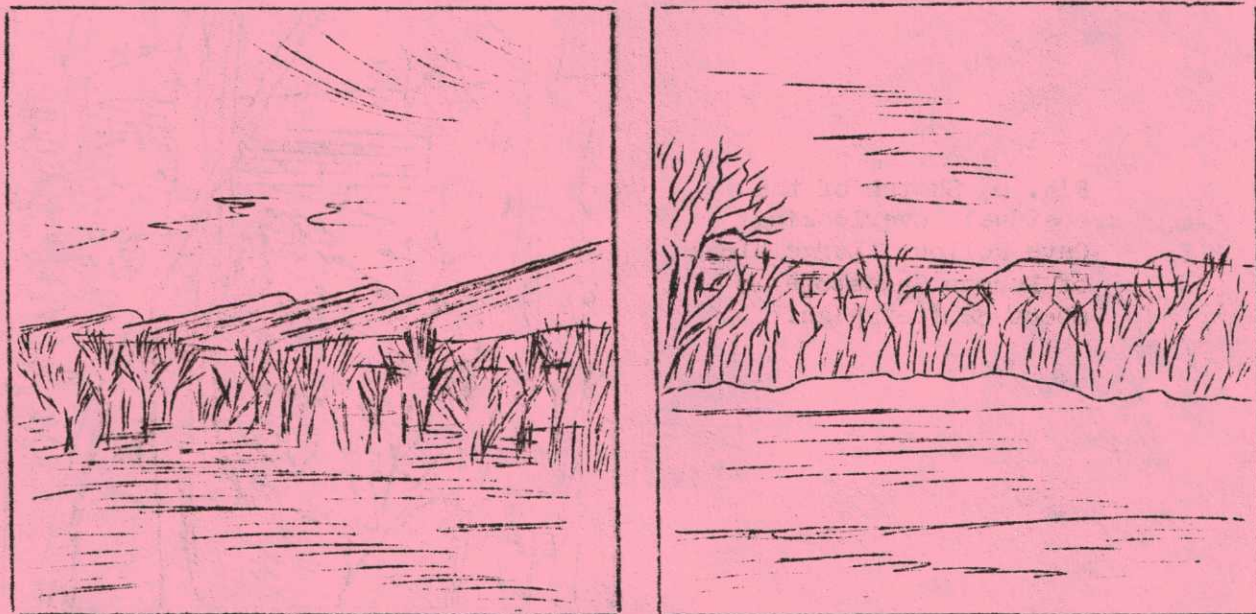


Fig. 7 Hand-drawn sketch of the west and east flanks of Chestnut Ridge Anticline showing scarp slope - dip slope relationships and the asymmetry of the fold.

The pertinent portion of the quadrangle was enlarged photographically to a scale of 1:4,800 and the enlargement is used as the base map for geologic field mapping.

STOP 2: LAUREL CAVERNS SITE #1 - CAVE HOLLOW OVERLOOK

16. We leave the bus where Cave Hollow Overlook Trail crosses the main entrance road. Walk along the trail to the overlook. The boardwalk is supported by one of the angular blocks of Pocono Sandstone which crept downslope from its joint faces. The steep slopes below are "littered" with these blocks. Distortion of the beds resulted in jointing of the rocks, and the jointing of the Loyalhanna Formation resulted in the formation of the caverns.

Walk to the parking lot and to the CAVE INN RESTAURANT for lunch.

Fig. 3 Sketch of the boardwalk overlooking Cave Hollow. Large block of Pocono Sandstone is about 32 feet high.



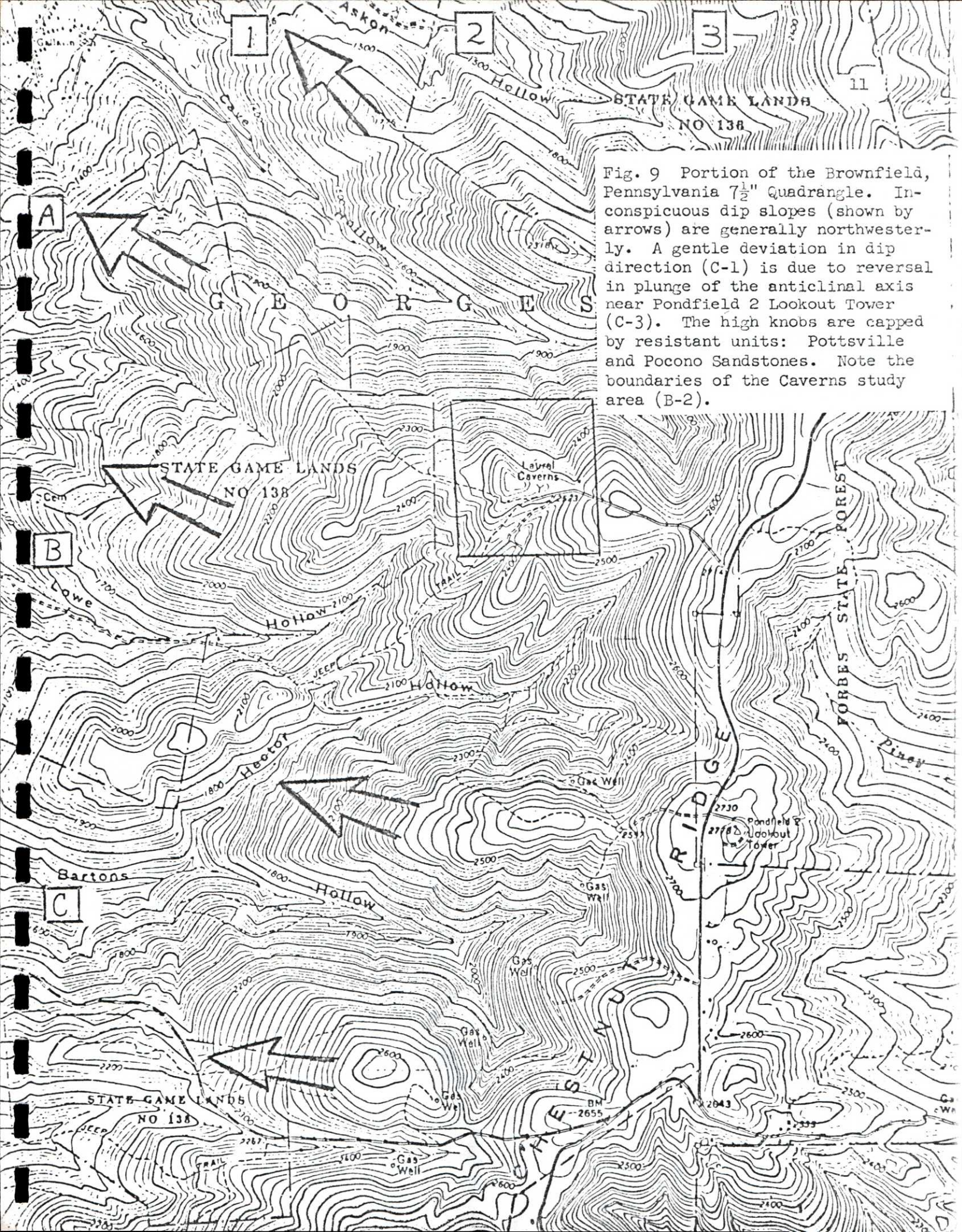
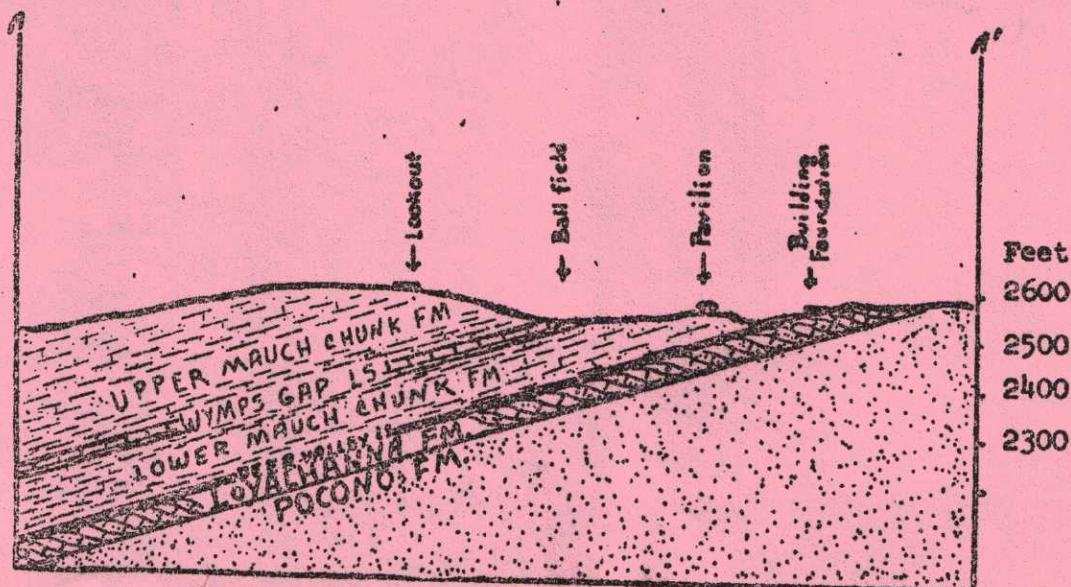
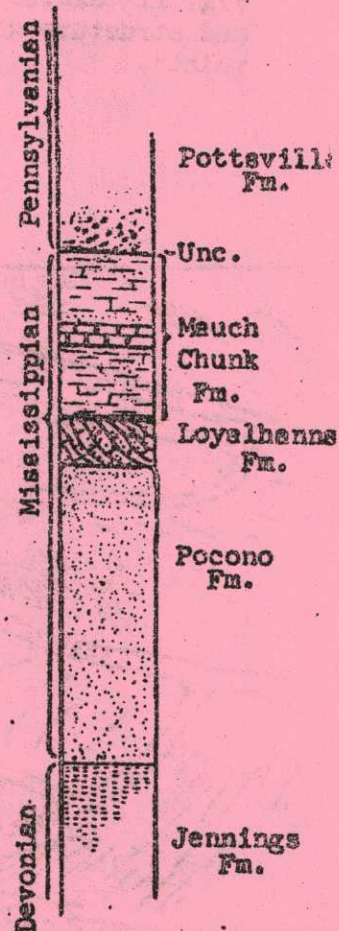
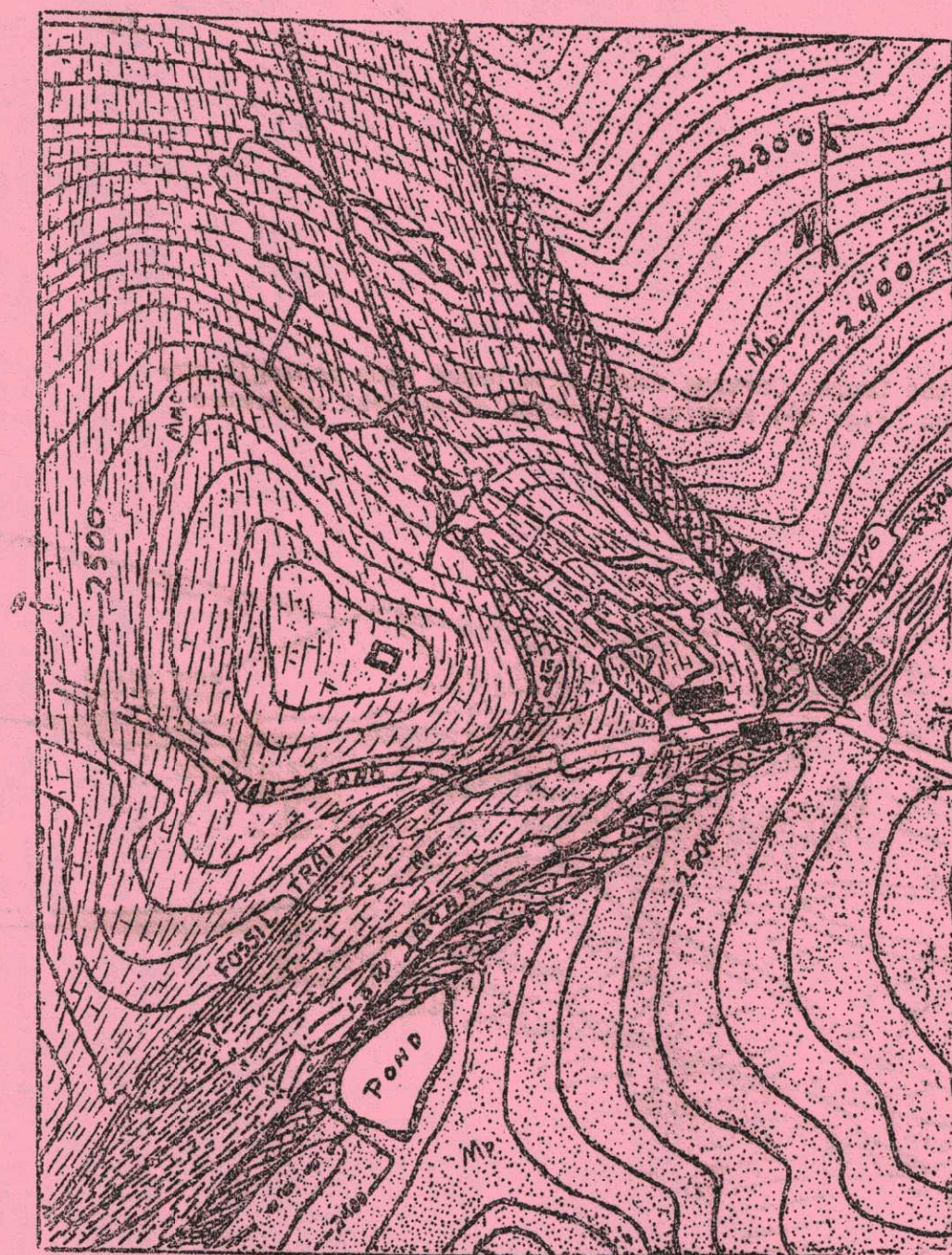


Fig. 10 Caverns
outline superimposed
on geologic map,
Laurel Caverns Study
Area.

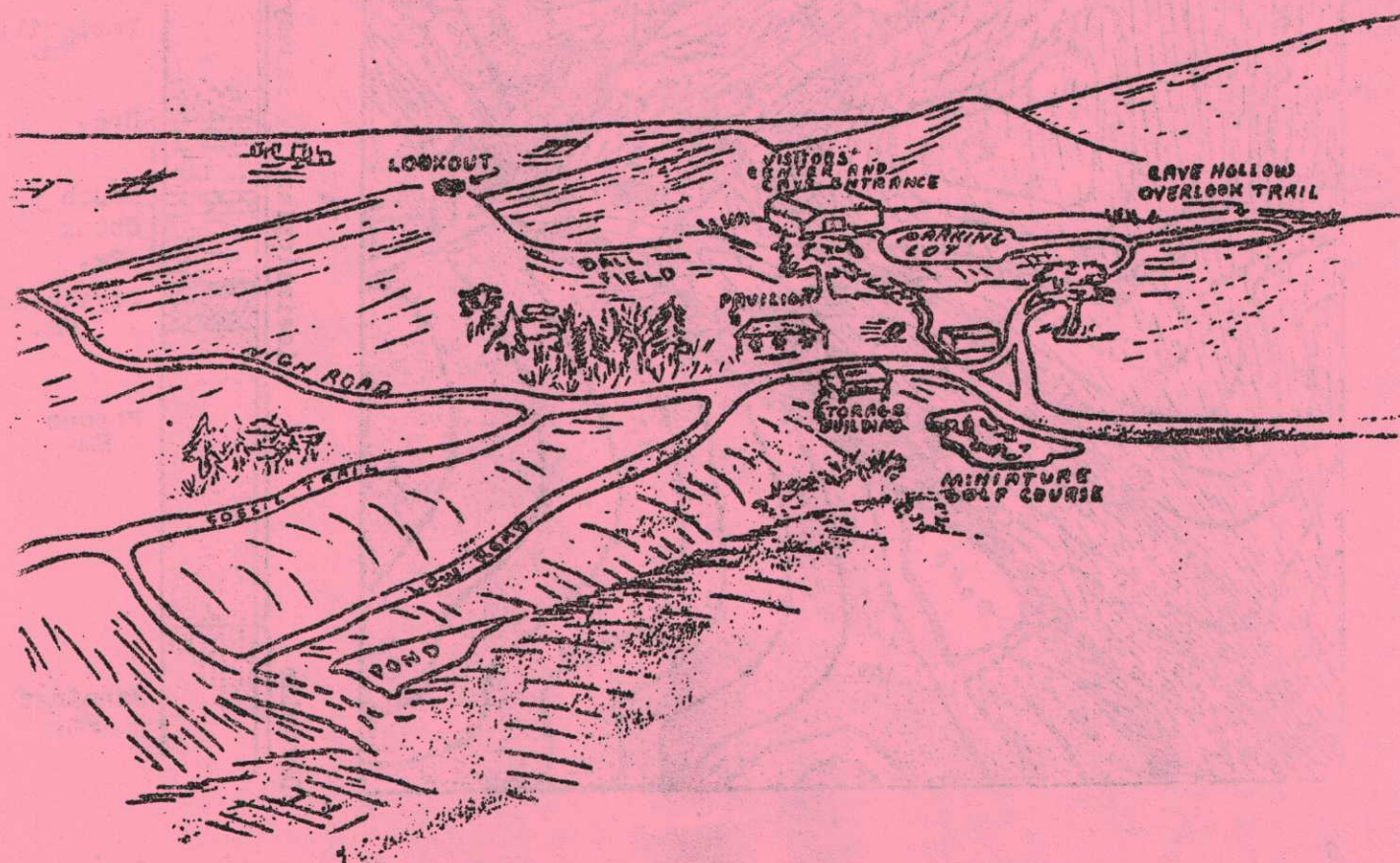


Feet
2600
2500
2400
2300

Horizontal and
vertical scales
1" = 400'

Contour interval
20 feet

Fig. 11. Sketch of the Laurel Caverns study site, based upon geologic map and structure section (Fig. 10) showing locations of several reference points.



SITE #2 - LAUREL CAVERNS TOURS (OPTIONAL)

17. Members of the park staff are available to conduct the short tour and to supply information concerning the longer one. Victor A. Schmidt of the University of Pittsburgh has recently completed a map of the caverns. The map is included in this guide and should be used by those who explore the non-commercial portions of the caves.

The following information concerning the caves was received from Dr. Schmidt:

Laurel Caverns (formerly known as Dulany Cave) is currently the longest (2.3 miles) and deepest (464 ft.) surveyed cave in Pennsylvania. It has a long and interesting history of exploration going back to September 11, 1816 when John A. Paxton of Philadelphia explored many of the currently-known passages and gave a remarkably accurate description of the cave.

For many years the cave was a favorite destination for cave explorers from nearby Uniontown and Pittsburgh, and when Ralph C. Bossart of Braddock camped at the cave entrance from May 20 to September 7 in 1931, he registered 1780 persons who entered the caverns. A portion of the upper maze section was commercially developed and opened to the public in 1964. Since then many of the passages above the Dining Room have been developed for visitors.

Laurel Caverns is unique among commercial caves in a number of ways. Since secondary calcite deposits (speleothems) are almost totally absent, the bedrock walls themselves are a prime exhibit showing the differentially-weathered cross-bedded nature of the formation. Since the Loyalhanna Formation is about 50 feet thick here the cave passages are confined to an inclined planar configuration that allows the attainment of considerable depth without any great vertical drops. Measurement of the exposed contact between the Loyalhanna and Deer Valley units at three points in the commercial section yielded a strike of N25°E and a dip of 13° west. This agrees well with the overall attitude of the plane to which the entire cave is confined, though there may be a steepening of dip of one or two degrees in the lower sections of the cave.

Quartz sand grains account for about 50% of the Loyalhanna. In a number of places it is easy to observe where the cementing calcite has been leached away, leaving the sand exactly in place faithfully recording cross-bedding and even joint cracks of hairline thickness although the sand grains are no longer cemented in place. Several short sections of passage in the caverns were dug out of this primary fill during commercialization.

The enclosed map shows that the orientation of the passages is joint-controlled. Enlarged joints are frequently visible in the ceiling. Faulting has also played an important role in the development of the cave pattern. A striking display of slickensides due to a bedding-plane fault may be seen on the ceiling immediately in front of the Pillar of Hercules. A prominent fault cuts through the formation in the vicinity of the Dining Room, undoubtedly contributing to the extensive ceiling collapse and widespread fracturing in this part of the cave. The strike of this fault nearly parallels that of the formation itself.

SITE #3 - PARKING LOT AND STAIRWAY LEADING TO OLD VISITORS' CENTER

18. As you ascend the stairs look to the right for outcrops of a strongly cross-stratified sandstone. This is the Loyalhanna Formation in which Laurel Caverns formed. The very thin (2-3 inches) bed of limestone overlying the Loyalhanna is a western "feather edge" of the Deer Valley Limestone (Flint, 1965).

At the northeastern edge of the parking lot, the surface of the Pocono Sandstone is exposed at an elevation of 2460 feet.

Follow the outcrop of the Loyalhanna to the top of the stairs, then turn right and walk to the ball field.

SITE #4 - BALL FIELD

19. The jumble of white rocks striking northwest across the field represents the scarp edge of the Wymps Gap Limestone, a 17-foot thick marine member of the Mauch Chunk Formation. The Wymps Gap was once referred to as the "Greenbrier of Pennsylvania" but was renamed by Flint (1965) to effect clarification of the unit which thickens greatly in West Virginia and in Maryland.

The Mauch Chunk is part of a province dominated by Appalachia. Its thickness to the east approaches 3000 feet, and it thins to the northwest (Dunbar, 1963). It represents a low delta and probably accumulated under a climate of abundant but seasonal rainfall. Here, the Mauch Chunk represents a deltaic - marine - deltaic environment with occasional transgressions of the Mississippian sea from the south.

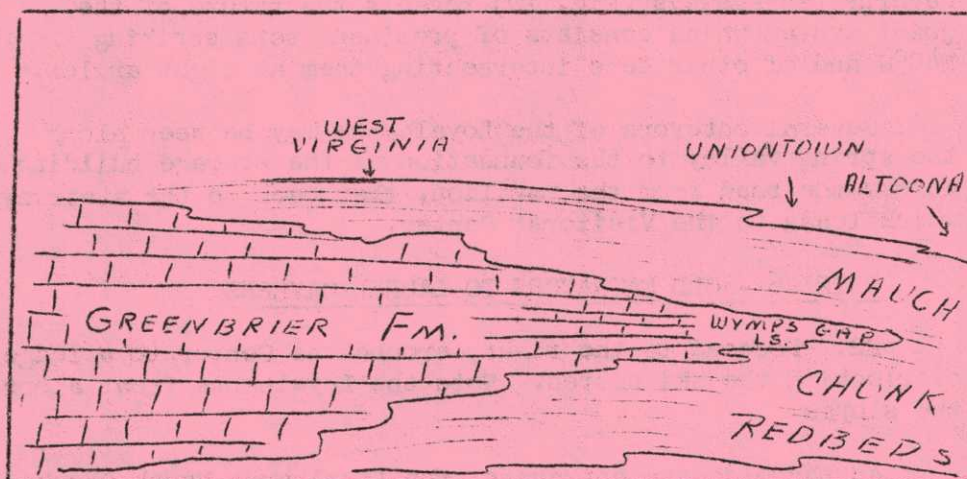


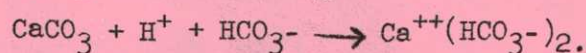
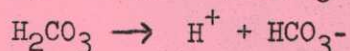
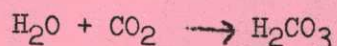
Fig. 12 Sketch of the Greenbrier Series of West Virginia and the Wymps Gap Limestone of the Mauch Chunk Formation in Pennsylvania at Chestnut Ridge.

20. Follow the Wymps Gap outcrop to the edge of the road. Look along the shoulder of the road near the stand of trees just south of the pavilion for crinoid stem fragments, gastropods, corals, trilobites, bryozoans, brachiopods, blastoids, cephalopods, mollusks, and teeth (deltodus). Fossils are very abundant all along the Trail.

SITE #5 - LAUREL SPRING ENTRY INTO LAUREL POND

21. Walk down Fossil Trail to a small crossing at the breastwork of the dam (Laurel Pond). Look across the Pond for an outcrop of the Pocono Sandstone. At a small gully at the northeastern edge of the Pond where the spring enters the dam, you can see an unusual phase of the Loyalhanna Formation. The cross-stratified pattern is present in the soil, but only the quartz sand grains remain after the calcite cement leached out.

This is part of the story of Laurel Caverns. Water and carbon dioxide combined to form carbonic acid. The acid reacted with the limestone to form a water-soluble bicarbonate:



The joints in the Loyalhanna exposed its calcareous component to the leaching process. The outline of the caverns passageways (Fig. 10) reveals the nature of the joint system which consists of prominent sets striking N40°W and of other sets intersecting them at right angles.

Several outcrops of the Loyalhanna may be seen along the spring valley to the foundation of the storage building across the road from the pavilion, then back to the stairway which leads to the Visitors' Center.

SITE #6 - OLD ENTRANCES TO LAUREL CAVERNS

22. Proceed to the right, around the Center to a ledge overlooking the ski slopes. Note the Loyalhanna float along the slopes.

At the old cave entrances, the Loyalhanna-Mauch Chunk contact is clearly exposed. The thin unit just overlying the Loyalhanna is the Deer Valley Limestone.

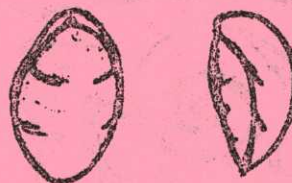
Fig. 13 Representative Wympe Gap Limestone Fossils, Chestnut Ridge Anticline, Laurel Caverns Study Area. All sketches were made from actual samples.

PHYLUM BRACHIOPODA

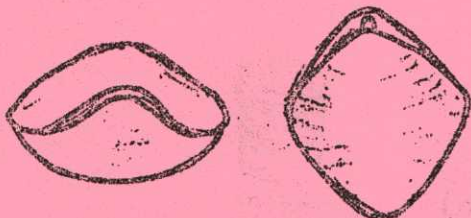
Linoproductus ovatus - Hall



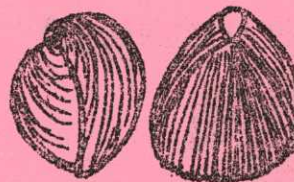
Dielasma illinoiense - Weller



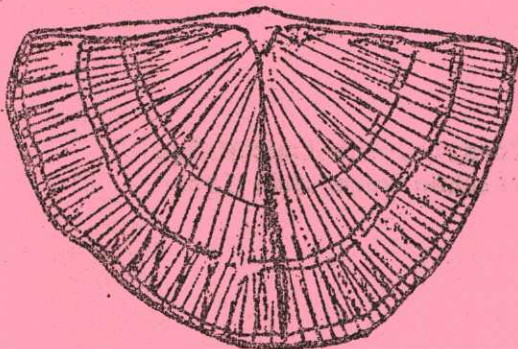
Composita subquadra - Hall



Eumetria vera - Hall

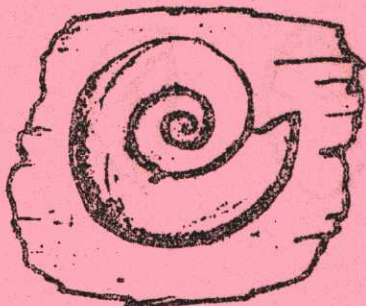


Derbya crassa - Meek and Hayden



Spirifer pellaensis - Weller



Gastropod (saparollus)Coral (zaphrentis)

Mollusk
(Pelacypod: allorisma
terminale)

Blastoid (pentremites)

x3

Trilobite (phillipsia)

Crinoid
(agassizocrinus)

Deltodus

Fig. 14 Representative Wympe Gap Limestone fossils, Chestnut Ridge Anticline, Laurel Caverns Study Area. All sketches were made from actual samples.

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ENGINEERING GEOLOGY AT TWO SITES ON
INTERSTATE 279 AND INTERSTATE 79 NORTHWEST
OF PITTSBURGH, PENNSYLVANIA

by

Norman K. Flint
University of Pittsburgh

and

James V. Hamel
South Dakota School of Mines and Technology

Introduction

Recent construction of Interstate Route 279 (Legislative Route 1016, Section 12) near Glenfield, Pennsylvania (see index map Fig. -1) resulted in unexpected landsliding and costly remedial excavation. A detailed geologic study of the site shows that the recent landsliding occurred where ancient slide masses at the horizon of the Pittsburgh Redbeds (claystone) were undercut. A similar geologic setting exists on nearby Interstate Route 79 (Legislative Route 1021, Section 6), not yet constructed, where former landsliding in the redbeds is recognizable in the surface morphology.

The purpose of the field trip is to observe post-construction conditions on I-279 where extensive failures in the weak redbeds have occurred, and to discuss pre-construction conditions at that site. Then a study of similar, pre-construction conditions on I-79 will focus attention on the value of careful geologic studies in recognizing potential slope instability before the construction stage is reached. Detailed geologic mapping of the Pittsburgh Redbeds, and the identification of extensive ancient landsliding along the outcrop trace of this weak unit is the key to advance recognition of sites which may present slope stability problems during and after construction.

Geology of Field Trip Area

The field trip sites are in a highly dissected, hilly area having a relief of 300 to 400 feet. Both I-279 and I-79 in the study areas are located on steep, wooded valley slopes. Although the rock strata of the area appear to be flat-lying they are actually gently folded. Stratigraphic units range from a few inches to 30 or 40 feet thick. Beds are the cyclothemic, coal-measure type occurring in the Conemaugh Group (see Fig. -2). Figure -3, a generalized stratigraphic section of the area, shows that several different rock types occur within a

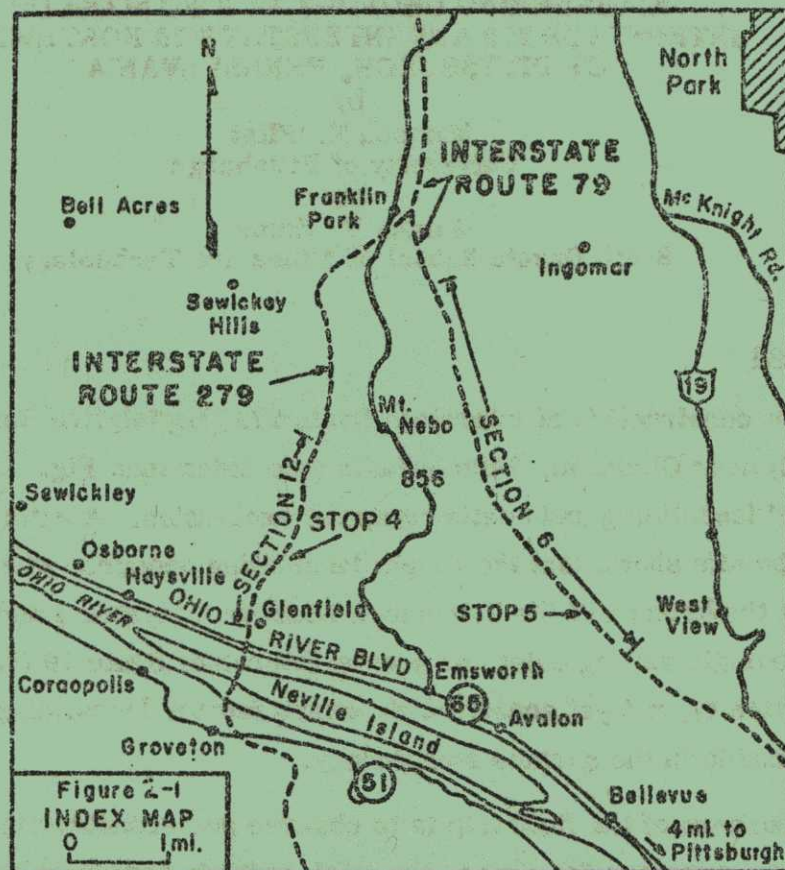


FIGURE -1. Index map.

vertical distance of a few tens of feet. From the engineering geology standpoint the critical units are the Pittsburgh Redbeds, Ames Limestone, and an unnamed claystone unit immediately above the Ames. Together, these beds form a weak zone 50 to 60 feet thick that is prone to landsliding.

The Pittsburgh Redbeds are composed of claystone which is highly fractured in apparently random directions. Most of the fracture surfaces are slicken-sided.* Scattered small limestone nodules occur in the redbeds at some places. Although dull red is the dominant color of the unit, other colors such as pale green, gray, greenish gray, and purple are also present. Upon exposure, the

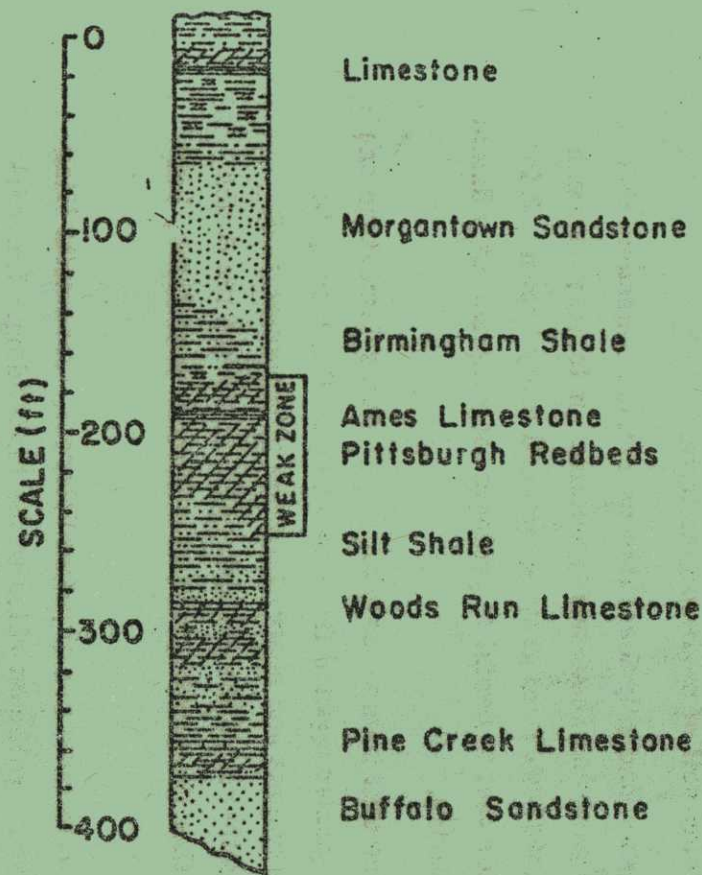
*This lithology is referred to as "indurated clay" by the Ohio River Division, U.S. Army Corps of Engineers and certain other organizations.

SYSTEM	GROUP
PERMIAN	Dunkard
PENNSYLVANIAN	Monongahela <i>Pgh Coal bed</i> Conemaugh <i>Upper Freeport Coal bed</i> Allegheny Pottsville

Ft.
1200
800
400
0
Scale

*Exposed rocks
in study area*

FIGURE 2. Stratigraphic Position of Exposed Rocks



KEY TO SYMBOLS

	Claystone (Redbeds)		Limestone
	Sandstone		Calcareous Shale
	Shale, Silty or Sandy		Calcareous Sandstone
	Coal		Shale

FIGURE 2-3. Stratigraphic Section

redbeds begin to disintegrate (ravel) within a few days to a few weeks. They ultimately weather to a silty clay soil of medium plasticity.

The Ames Limestone is an abundantly fossiliferous marine limestone that commonly occurs as a single hard bed about two feet thick. It is gray on fresh surfaces but weathers to various shades of gray, green and rusty brown. It is an excellent stratigraphic guide that is useful in geologic mapping and as a datum bed for plotting structure contours.

An unnamed gray claystone unit immediately above the Ames Limestone has a thickness of about 15 feet. It grades upward from nonbedded claystone in its lower part to poorly bedded claystone and shaly claystone in its upper part. This is a weak unit which, together with the Pittsburgh Redbeds and the Ames Limestone, represent a zone that has participated in numerous landslides, both ancient and recent.

Although the beds of this weak zone are of prime interest, those units lying below and above have also played significant roles in the landsliding. Immediately below the Pittsburgh Redbeds lies a relatively strong silt shale unit that ranges from 30 to 50 feet in thickness. The shear surfaces of the I-279 slides were positioned at the contact between this silt shale and the Pittsburgh Redbeds. Above the weak zone lies the Birmingham Shale whose thickness is dependent on the stratigraphic position of the base of the disconformable Morgantown Sandstone. The latter is a channel sandstone that in some places channels downward in the section far enough to lie directly on the weak claystone, there being no Birmingham Shale present at such localities. These stratigraphic relations are significant from the engineering geology standpoint because contact type springs occur at the sandstone-claystone contact. The spring water which infiltrates colluvium of the Pittsburgh Redbeds below is probably a factor in facilitating further movement of this material.

STOP #1 (90 minutes)

**Engineering Geology At Two Sites on Interstate 279 and
Interstate 79 Northwest of Pittsburgh, Pa.**

by

**Norman K. Flint, Professor
University of Pittsburgh, Pa.**

and

**James V. Hamel, Professor
South Dakota School of Mines & Technology**

Interstate 279 Landslides

Several landslides that developed during construction of I-279 resulted from undercutting and reactivation of unrecognized ancient slide masses in the Pittsburgh Redbeds. Two of these have been described and analyzed in detail (Hamel and Flint, 1969). Figure 2-4 is a selected topographic map on which a portion of I-279 near Glenfield is plotted. Also plotted is the outcrop position of the weak zone that includes the Pittsburgh Redbeds. Extensive landsliding occurred at this locality during construction. Topographic benching within the weak stratigraphic zone is clearly evident on the map. A section (A-A') at Station 928+50 (Fig. 2-5) shows the highway design slope and its relation to the weak zone. Landsliding occurred there when a cut was made in the colluvium on a 1 1/4:1 slope (39°). Remedial excavation flattened the slope to 3:1 (18°) on the redbeds. Because landsliding continued even at that slope, a bench was cut at the base of the redbeds to collect the material which slumps onto it as a stable slope is being established.

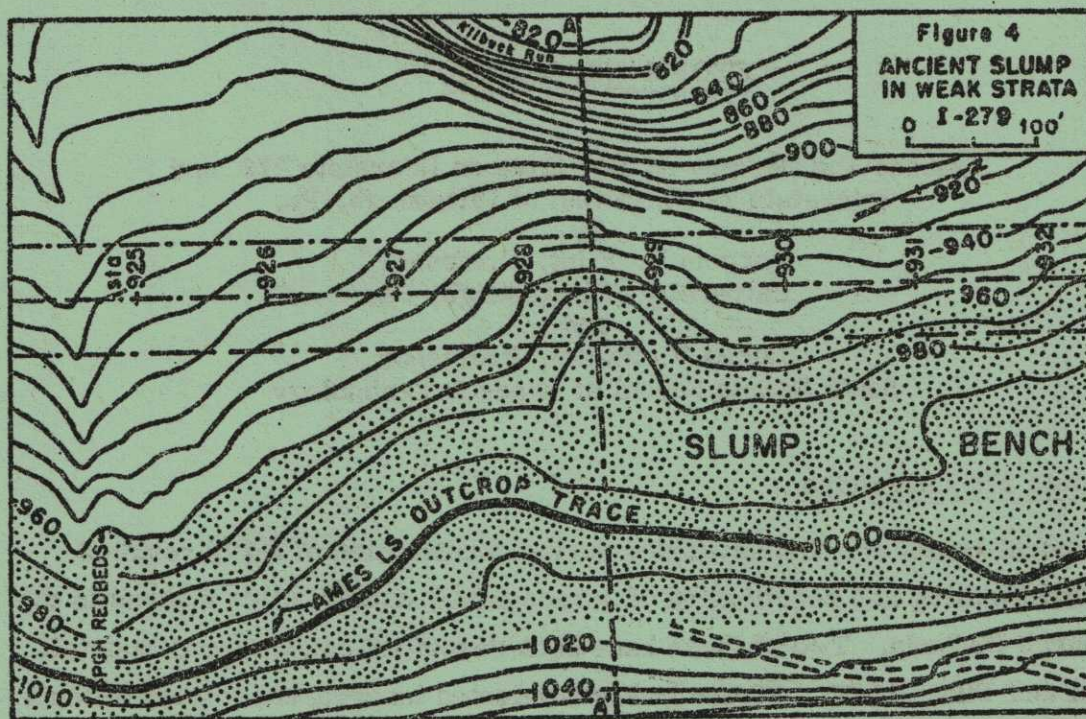


FIGURE 2-4.

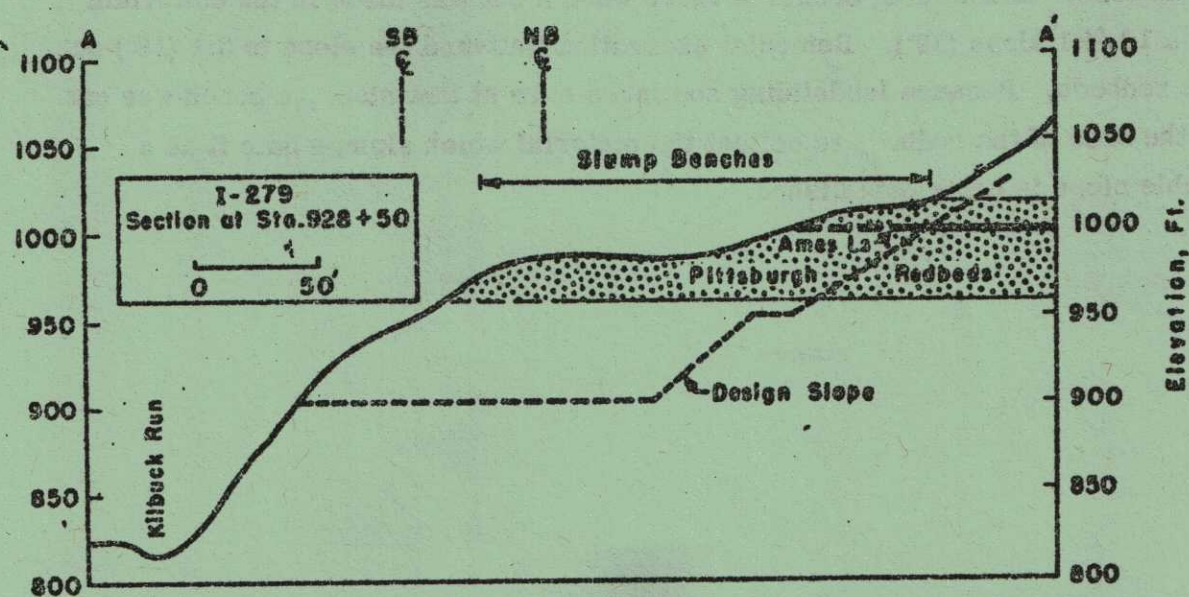


FIGURE 2-5. Ancient slump benches in weak strata that were undercut

STOP #2 (60 minutes)

**Engineering Geology At Two Sites on Interstate 279 and
Interstate 79 Northwest of Pittsburgh, Pa.**

by
**Norman K. Flint, Professor
University of Pittsburgh, Pa.**

and
**James V. Hamel, Professor
South Dakota School of Mines & Technology**

Potential Landslide Area on Interstate 79

On I-79 between Stations 341 and 344, pre-construction conditions similar to those on I-279 are present (see Figs. 2-6 and 2-7). There is a prominent topographic bench on the valley wall at the position of the Pittsburgh Redbeds. This bench is interpreted as the upper level of an ancient slump mass which is probably bounded by a shear zone at its base.

A geologic section at Station 342 (Fig. 2-7) shows the relation between the highway grade, the weak Pittsburgh Redbeds and the inferred shear zone. All these features including exposures of the Ames Limestone, Pittsburgh Redbeds and the underlying silt shale will be seen and discussed in the field when the I-79 site is visited.

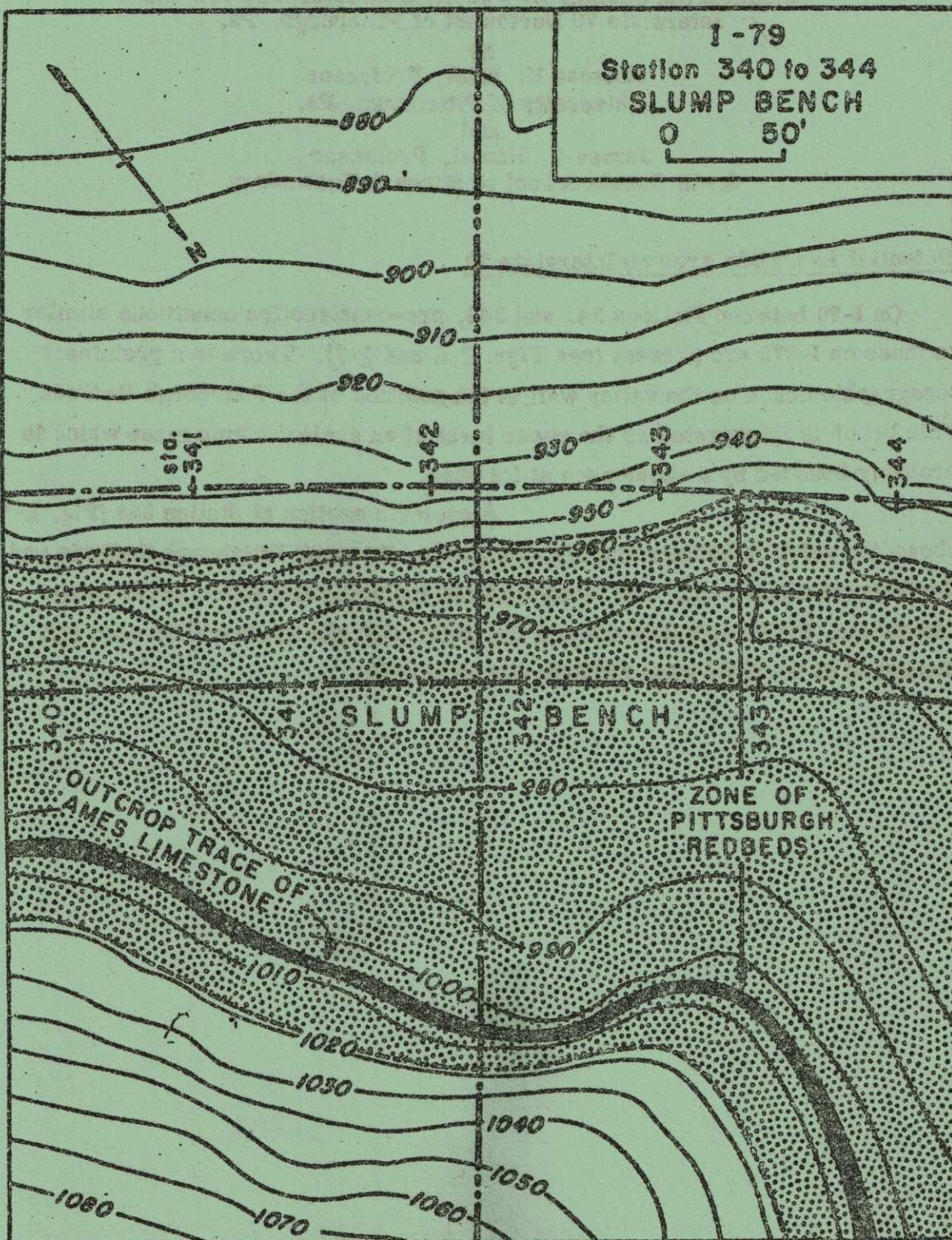


FIGURE 2-6. I-79 Station 340 to 344 slump bench

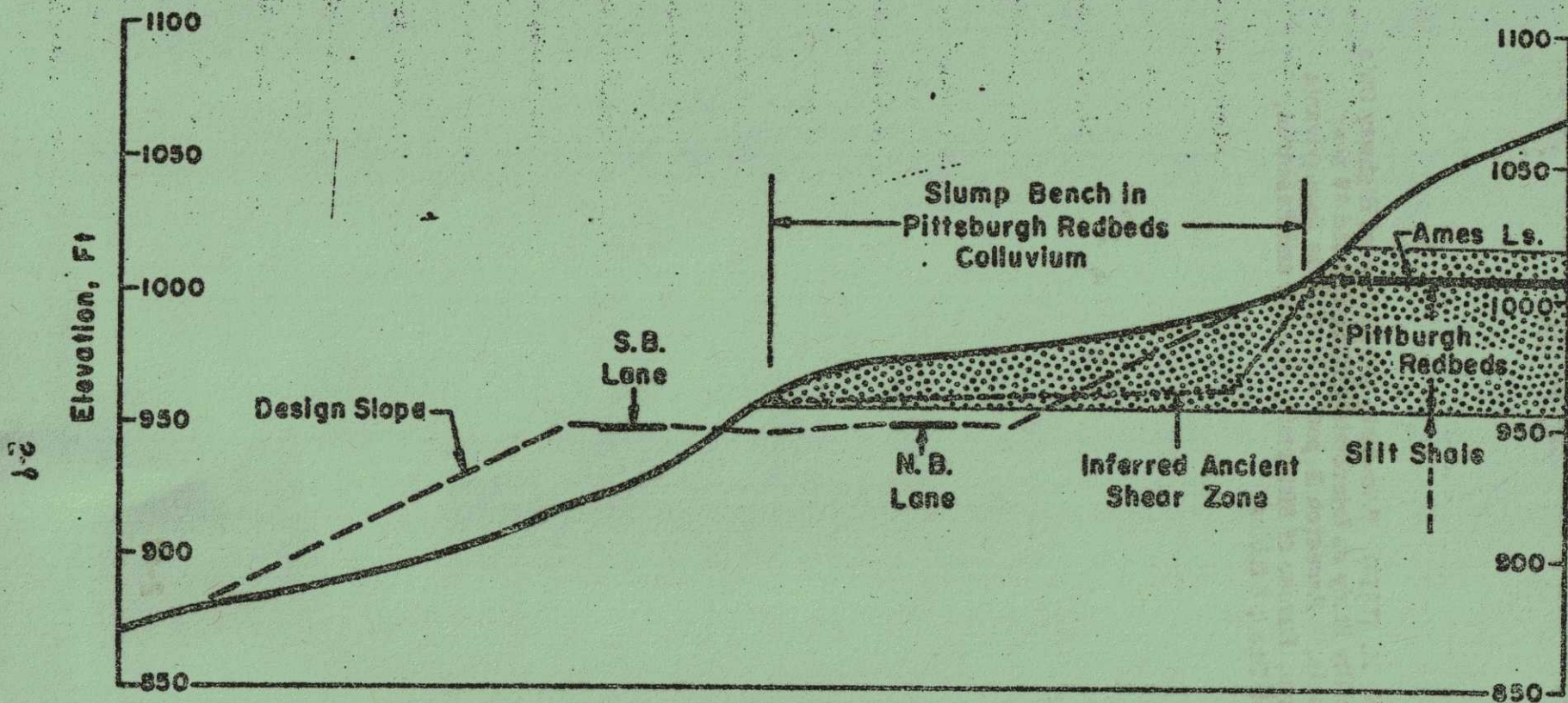


Figure 2-7
 GEOLOGIC SECTION ON I-79 (L.R. 1021, SEC. 6)
 AT STATION 342 + 00
 0 50'

FIGURE 2-7. Geologic section on I-79 (L. R. 1021, sec. 6) at Station 342 + 00

Reference

Hamel, J. V. and Flint, N. K. (1969). "Analysis and Design of Highway Cuts in Rock: A Slope Stability Study on Interstate Routes 279 and 79 near Pittsburgh, Pennsylvania," Research Report submitted to Pennsylvania Department of Highways, Bureau of Materials, Testing and Research, Harrisburg, 130 p.; 45 figs.; 6 tables.

NUCLEAR POWER

Jessie G. Donahue

University of Pittsburgh

Increasing demand for electrical energy has lead to the utilization of nuclear power to generate electricity. The first nuclear power plant became operational in 1957 at Shippingport, Pennsylvania. At present, 22 plants are operating throughout the U.S.A.

Operation: U^{235} is the only naturally occurring fissionable material and is the fuel for today's nuclear fission power plants. The plants contain a core which houses a number of rods composed of a ceramic-like compound containing the U^{235} . A controlled chain reaction takes place. The heat generated by this chain reaction warms water continually flowing past the rods. The heated water either turns to steam (boiling water reactor) or, if confined under pressure (pressurized water reactor) heats water in adjacent pipes which turns to steam, and then runs the turbine and generates electricity.

Safety Factors: The core of the nuclear power plant contains a great deal of dangerous, highly radioactive material. The main precaution taken to prevent this material from entering the environment is appropriate shielding, a pressure vessel to contain the core and high pressure pipes for conducting fluid to and from the core. The most feared accident is a "loss of coolant accident" in which some failure of the system would result in a loss of the cooling fluid flowing past the fuel rods. The result would be a sharp increase in the operating temperature in the core, with

the possibility of the rupture of the pressure vessel and the release of large quantities of radioactive material to the environment. A system called the "emergency core cooling system" (ECCS) is built into every water-cooled reactor and is designed to supply cooling liquid to the core in case of a loss of primary coolant. Unfortunately, the ECCS has never been shown to be capable of operation and has not operated in model tests. The only research on the loss of coolant accident was being conducted at Oak Ridge, Tennessee by the Atomic Energy Commission. This research was cancelled in February, 1971, although the researchers had begun to raise some troubling questions about the margins of safety in water cooled reactors. W. B. Cottrell, director of nuclear safety at Oak Ridge, said "no one really knows what will happen in a reactor core in the event of a loss of coolant accident ..." (Science, 1972, V. 177, p. 970). In spite of Cottrell's pleas to continue funding of safety research, the project was stopped. The AEC relies primarily on the integrity of its pipes and pressure vessels to prevent an accident. Their construction is such that the core integrity should survive a direct hit by a crashing airplane, or tornado, or earthquake damage.

Pollution: Low level radioactive wastes are released, after dilution, into the air and water. Highly radioactive wastes must be contained and stored. The fuel rods run down after 3 to 4 years and about 20% of the entire core is replaced yearly. The spent fuel rods are transported to special fuel reprocessing plants run by the AEC; two such plants exist in the U.S. Here the rods are dissolved in acid and the remaining U^{235} removed to be made into new fuel rods. The residue from this process is highly radioactive and must be permanently removed (600 to 800 years) from our

environment. The AEC wishes to dispose of these liquid wastes by pumping them into deep underground salt beds. The first proposed disposal site in Kansas was abandoned because the local population refused to have it. A site in New Mexico is presently under consideration. The two problems are: (1) permanent disposal of highly radioactive wastes and (2) evaluation of affect of adding low level radioactive wastes to the environment.

Breeder Reactors: The isotope U^{235} is only about 0.7% of all uranium and at the present rate of use, the supply will be exhausted in 20 years. Breeder reactors make fissionable materials (plutonium 239 and uranium 233) from non-fissionable material (uranium 238 and thorium 232). A breeder reactor must be activated with U^{235} but thereafter it will produce more fissionable material than is necessary to operate the reactor. Suitable non-fissionable materials (U^{238} , Th^{232}) are very abundant. Plutonium is the main fissionable material produced in a breeder reactor and must be handled very carefully. One dust-sized particle, if inhaled, could be lethal.

NATIONAL ASSOCIATION OF GEOLOGY TEACHERS - EASTERN SECTION

SATURDAY, APRIL 14 SCHEDULE*

- 8:30 a.m. PESTS Meeting
- 9:00 a.m. "A possible model for teaching environmental geology", presentation by Mr. Steve Dodin, Department of Earth and Planetary Sciences, University of Pittsburgh.
- 9:30 a.m. "Introduction to Laurel Caverns", presentation and field trip preview by Dr. Victor Schmidt, Department of Earth and Planetary Sciences, University of Pittsburgh.
- 10:00 a.m. "Landsliding problems in the Pittsburgh area", presentation and preview of field trip #2 by Dr. Norman K. Flint, Department of Earth and Planetary Sciences, University of Pittsburgh.
- 11:15 a.m. Departure of field trip #1 to Chestnut Ridge and Laurel Caverns. Lunch can be purchased at the Cave Inn, Laurel Caverns.
- 12:30 p.m. Departure of field trip #2.

NOTE: Buses for field trips depart from the loading dock at Langley Hall.

* all presentations will be held in the Oakland Room, Stouffer's Restaurant.

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